Interlock	LIT011B HH	Design Intent	Protection of plant against overfilling of QA-8008 / impossibility to use Closed Drain				
Initiators	LIT011B HH	P&ID	12311-2		Final elements	ESD Level 2	
Remarks							

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overfilling of QA-V-8008 leading to liquid carry over to cold vent. Release of liquid from cold vent and possibile pool fire			a	Pump QA-P-8006A/B failure	0,05	0,10	0,10	0,10	0,10	1,00	5,00E-06		
				b	Pump QA-P-8007A/B failure	0,05	0,10	0,10	0,10	0,10	1,00	5,00E-06		
				c	Failure of LIC-012 stopping pump QA-P-8006A/B	0,10	0,10	1,00	0,10	0,10	1,00	1,00E-04		
				d	Spurious closure of ESDV-008	0,05	0,10	1,00	0,10	0,10	1,00	5,00E-05		
				e	Spurious closure of XV-031A/B in pump discharge line	0,05	0,10	1,00	0,10	0,10	1,00	5,00E-05		
	HEALTH	F	1,00E-02									2,10E-04	4,76E+01	**NC**
	ENVIRONMENTAL	F	1,00E-02									2,10E-03	4,76E+00	**NC**
	ASSET	C	1,00E-05									2,10E-03	4,76E-03	**2**

NOTES

H	Release of gas and fire from cold vent stack. Minor impact to operators since the fire is located inside a fenced area (normally unmanned)
E	Release of gas and fire from cold vent stack.Limited impact; Dispersion of combustion fumes in case of fire
A	Limited impact ,possible repair of flame arrestor and cold vent piping ,complete plant shutdown for 3 days for maintenance plus the cost of repair (15 M$)
1	
2	
3	
4	
5	8760 h/y
6	Availability of spare pump automatically started up by control loop
7	LIT012 HH alarm, with more than 10 minutes / Indication of pump state in control room
8	Reduced vulnerability due to fact that release is in safe location and not manned area
9	
10	
11	
12	Team agrees to select a SIL 1 requirement for the analysed SIF

Note for Verification	The necessary actions for ESD2 to mitigate this event are : Compressor shutdown

Interlock	LIT002_003_032 HH	Design Intent	Protection of plant against low low pressure in instrument air header							
Initiators	LIT002_003_032 HH	P&ID	12369			Final elements		ESD Level 2		
Remarks										

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overfilling of existing KO drum leading to possible excessive flaring leading to mechanical damage to burners			a	Activation of ESD level 1 leading to level increase of existing KO drum	0,10	1,00	0,10	0,10	0,10	1,00	1,00E-04		
				b	Overfilling of QA-8005A/B	0,10	1,00	0,10	0,10	0,10	0,10	1,00E-05		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,10E-04	9,09E-01	**NC**
	ENVIRONMENTAL	D	1,00E-04									1,10E-03	9,09E-02	**1**
	ASSET	C	1,00E-05									1,10E-03	9,09E-03	**2**

NOTES

H	Liquid carry over to flare. Possible significant flaring leading to injury.
E	Liquid carry over to flare. Possible significant dispersion of combustion gas.
A	Potential damage to flare accessory ; Complete plant shutdown for 3 days for maintenance plus the cost of repair (15 M$).
1	
2	
3	
4	
5	8760 h/y
6	
7	LI 001H
8	
9	
10	
11	
12	Team agrees to maintain 2 oo 3 voting logic in order to have high realiabilty against spurious trip

Action	The necessary valves for ESD1 safe activation are:

Interlock	LIT037_341_344 HH	Design Intent	Protection of plant against low low pressure in instrument air header							
Initiators	LIT037_341_344 HH	P&ID	12356			Final elements		ESD Level 2		
Remarks										

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overfilling of existing KO drum leading to possible excessive flaring			a	Activation of ESD level 1 leading to level increase of existing KO drum	0,10	1,00	0,10	0,10	0,10	1,00	1,00E-04		
				b	Overfilling of QA-8005A/B	0,10	1,00	0,10	0,10	0,10	0,10	1,00E-05		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,10E-04	9,09E-01	**NC**
	ENVIRONMENTAL	D	1,00E-04									1,10E-03	9,09E-02	**1**
	ASSET	C	1,00E-05									1,10E-03	9,09E-03	**2**

NOTES

H	Liquid carry over to flare. Possible significant flaring leading to injury.
E	Liquid carry over to flare. Possible significant dispersion of combustion gas.
A	Potential damage to flare accessory ; Complete plant shutdown for 3 days for maintenance plus the cost of repair (15 M$).
1	
2	
3	
4	
5	8760 h/y
6	
7	LI 341H
8	
9	
10	
11	
12	Team agrees to maintain 2 oo 3 voting logic in order to have high realiabilty against spurious trip

Action	The necessary valves for ESD1 safe activation are:

Interlock	PIT079A/B/C LL	Design Intent	Protection of plant against low low pressure in instrument air header		
Initiators	PIT079A/B/C LL	P&ID	12300-2	Final elements	ESD Level 2
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Loss of instrument air to user leading to loss of process control and uncontrolled unit shut down			a	Failure of PIC073 stopping the compressor QA-K-8002A/B/C	0,10	1,00	0,10	0,10	1,00	1,00	1,00E-03		
				b	Failure or air compressor QA-K-8002A/B/C	0,05	1,00	0,10	0,10	1,00	1,00	5,00E-04		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									1,50E-03	6,67E+00	**NC**
	ENVIRONMENTAL	E	1,00E-03									1,50E-03	6,67E-01	**NC**
	ASSET	D	1,00E-04									1,50E-03	6,67E-02	**1**

NOTES

H	Uncontrolled plant shud down leading to no impact to operators
E	Uncontrolled plant shut down; potential for flaring.
A	Uncontrolled plant shut down; potential for maintenance activity pre start up for 1 day (5M$)
1	
2	
3	
4	
5	8760 h/y
6	PZA-075A low low 1 pressure interlock to close ESDV-038 on header to existing facility
7	Availability of spare compressor, automatically started up by low pressure on PIC-073.
8	
9	
10	
11	
12	Team agrees to maintain 2 oo 3 voting logic in order to have high realiabilty against spurious trip .

Action	The necessary valves for ESD2 safe activation are:

Interlock	PDIT906 HH	Design Intent	Protection against pressurization at circuit start up		
Initiators	PDIT906 HH	P&ID	12210	Final elements	ESDV030A
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible gas hammering in down stream piping leading to potential mechanical damage. Limited leakage and fire.			a	Incorrect opening of ESDV 031A during start up due to misoperation.	0,05	0,10	1,00	1,00	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									5,00E-03	2,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Limited leakage leading to fire. Possible for permenant injury.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of compressor circuit. Two days complete shutdown plus repairing of weak points (9 M$)
1	
2	
3	
4	
5	Active only during start up
6	
7	ESDV 031A is equipped with limit switches with alarm in DCS
8	
9	
10	
11	
12	

Action	N.A.

Interlock	PDIT907 HH	Design Intent	Protection against pressurization at circuit start up		
Initiators	PDIT907 HH	P&ID	12210	Final elements	ESDV031A
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible hammering in down stream piping leading to potential mechanical damage .			a	Incorrect opening of ESDV 031A during start up due to misoperation.	0,05	0,10	1,00	1,00	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									5,00E-03	2,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Limited leakage leading to fire. Possible for permenant injury.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of compressor circuit. Two days complete shutdown plus repairing of weak points (9 M$)
1	
2	
3	
4	
5	8760 h/y
6	
7	ESDV 031A is equipped with limit switches with alarm in DCS
8	
9	Assumed that 1/10 of times, the damage effectively occurs.
10	
11	
12	

Action	N.A.

Interlock	LIT101 LL	Design Intent	Protection against low low level in QA-V-8001 A leading to gas blow by to QA-V-8005A/B		
Initiators	LIT101 LL	P&ID	12211	Final elements	ESDV 103
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Gas blow by to the condensate suction drum QA-V-8005A leading to overpressurization. Possible mechanical damage.			a	Failure open of LV 102	0,10	1,00	0,10	1,00	1,00	0,01	1,00E-04		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									1,00E-04	1,00E-01	**1**
	ENVIRONMENTAL	D	1,00E-04									1,00E-04	1,00E+00	**NC**
	ASSET	D	1,00E-04									1,00E-04	1,00E+00	**NC**

NOTES

H	Significant leakage leading to fire. Possible for 1 fatality
E	Significant leakage of flammable gas and fire. Dispersion of combustion fumes.
A	Mechanical damage of condensate suction drum for long period + cost of repair. Spare drum is available (5 M$)
1	
2	
3	
4	
5	
6	PIC003 venting excess of pressure to flare circuit
7	
8	
9	PSV007A/B sized for this scenario
10	
11	
12	

Action	N.A.

Interlock	LIT107 HH	Design Intent	Protection of compressor QA-K-8001A due to liquid carry over from suction KO drum				
Initiators	LIT107 HH	P&ID	12211		Final elements		QA-K-8001A (T)
Remarks							

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overfilling of QA-V-8001A leading to liquid carry over to the compressor QA-K-8001A with possible mechanical damage			a	Spurious closure of ESDV 103	0,05	1,00	1,00	0,10	1,00	0,10	5,00E-04		
				b	Failure close of LV 102	0,10	1,00	0,10	0,10	1,00	0,10	1,00E-04		
				c	Manual valves in the condensate outlet line of QA-V-8001A closed due to misoperation	0,05	1,00	1,00	1,00	1,00	0,10	5,00E-03		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									5,60E-03	1,79E-01	**NC**
	ENVIRONMENTAL	D	1,00E-04									5,60E-03	1,79E-02	**1**
	ASSET	C	1,00E-05									5,60E-03	1,79E-03	**2**

NOTES

H	Damage to compressor internals leading to gas release to atmospher through secondary vent
E	Damage to compressor internals leading to gas release to atmospher through secondary vent
A	Mechanical damage of compressor and stop of production for long period (6 months) + cost of repair. In early production, a spare is avalable with no loss of production. In later stage, failure will lead to half of production loss.
1	
2	
3	
4	
5	
6	LV 102 is equipped with limit switches (with alarm in DCS)
7	LI108 H
8	Presence of compressor casing to reduce impact to people
9	High high vibration to shut down the compressor
10	
11	
12	

Action	The necessary valves for ESD3 safe activation are:

Interlock	PIT110 LL	Design Intent	Protection against low low pressure in compressor QA-K-8001A suction		
Initiators	PIT110 LL	P&ID	12212	Final elements	QA-K-8001A (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Compressor QA-K-8001A Surge leading to possible mechanical damage.			a	Manual valves in the suction line of QA-V-8001 A closed due to misoperation	0,05	1,00	0,10	0,10	1,00	0,10	5,00E-05		
				b	Spurious closure of ESDV 101A	0,05	1,00	0,10	0,10	1,00	0,10	5,00E-05		
				c	Failure close of PV 123	0,10	1,00	0,10	0,10	1,00	0,10	1,00E-04		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									2,00E-04	5,00E+00	**NC**
	ENVIRONMENTAL	E	1,00E-03									2,00E-04	5,00E+00	**NC**
	ASSET	C	1,00E-05									2,00E-04	5,00E-02	**1**

NOTES

H	Damage to compressor internals leading to gas release to atmospher through secondary vent
E	Significant leakage of flammable gas and fire. Dispersion of combustion fumes.
A	Mechanical damage of compressor and stop of production for long period + cost of repair. In early production, a spare is avalable with no loss of production. In later stage, failure will lead to half of production loss.
1	
2	
3	
4	
5	
6	Compressor anti surge controller
7	Low pressure alarm on PI112
8	
9	Vibration trip VS102A/B/C/D HH
10	
11	
12	

Action	The necessary valves for ESD3 safe activation are:

Interlock	PIT111 HH	Design Intent	Protection against high high pressure in compressor QA-K-8001A discharge		
Initiators	PIT111 HH	P&ID	12212	Final elements	QA-K-8001A (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overpressurization of QA-K-8001A discharge line leading to mechanical damage			a	Spurious closure of ESDV102A in discharge of compressor	0,05	1,00	0,10	0,10	1,00	0,01	5,00E-06		
				b	Spurious closure of ESDV032A upstream TI06	0,05	1,00	0,10	0,10	1,00	0,01	5,00E-06		
				c	Spurious closure of ESDV033A upstream TI04	0,05	1,00	0,10	0,10	1,00	0,01	5,00E-06		
				d	Manual valves on QA-E-8001A left closed due to misoperation	0,05	1,00	1,00	0,10	1,00	0,01	5,00E-05		
												0,00E+00		
												0,00E+00		
	HEALTH	B	1,00E-06									6,50E-05	1,54E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									6,50E-05	1,54E+01	**NC**
	ASSET	C	1,00E-05									6,50E-05	1,54E-01	**NC**

NOTES

H	Significant leakage of flammable gas and fire. Possible multiple fatalities
E	Significant leakage of flammable gas and fire. Dispersion of combustion fumes.
A	Mechanical damage of compressor and stop of production for long period + cost of repair. In early production, a spare is avalable with no loss of production. In later stage, failure will lead to half of production loss.
1	
2	
3	
4	Manual valve not normally operated during compressor running.
5	
6	Anti surge controller for the compressor QA-K-8001A/B/C/D
7	High pressure alarm on PI112 (a, b, c, d)
8	
9	PSV114A/B sized for blocked outlet scenario (a, b, c, d)
10	
11	
12	

Action	Consider to configure manual valve QAE8001A locked open

Interlock	TIT102 HH	Design Intent	Protection against high high temperature in compressor QA-K-8001A discharge				
Initiators	TIT102 HH	P&ID	12212		Final elements		QA-K-8001A (T)
Remarks							

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	More Temperature in the compressor QA-K-8001A discharge line leading to possible mechanical damage			a	Temperature More from upstream existing facility	0,05	1,00	1,00	0,10	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									5,00E-03	2,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Release of flammable gas and jet fire. Possible permanent injury
E	Release of flammable gas and jet fire. Limited impact due combustion gas dispersion.
A	Mechanical damage of compressor and stop of production for long period + cost of repair. In early production, a spare is available with no loss of production. In later stage, failure will lead to half of production loss.
1	
2	
3	
4	
5	
6	
7	High temperature alarm on TI103
8	
9	
10	
11	
12	

Action	The necessary valves for ESD3 safe activation are:

Interlock	VSHH101 HH	Design Intent	Protection against high high vibration of compressor's shaft		
Initiators	VSHH101 HH	P&ID	12212	Final elements	QA-K-8001A (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Excessive vibration leading to mechanical damage of compressor's shaft.			a	Condition for vibration (surge, liquid carry over, overspeed)	0,10	1,00	0,10	0,10	1,00	0,10	1,00E-04		
				b	Incorrect alingment	0,05	0,10	1,00	0,10	1,00	0,10	5,00E-05		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,50E-04	6,67E+00	**NC**
	ENVIRONMENTAL	E	1,00E-03									1,50E-04	6,67E+00	**NC**
	ASSET	C	1,00E-05									1,50E-04	6,67E-02	**1**

NOTES

H	Damage to compressor internals leading to gas release to atmospher through secondary vent
E	Significant leakage of flammable gas and fire. Dispersion of combustion fumes.
A	Mechanical damage of compressor and stop of production for long period + cost of repair. In early production, a spare is avalable with no loss of production. In later stage, failure will lead to half of production loss.
1	
2	
3	
4	
5	
6	Compressor anti surge controller
7	Availability of compressor alarm (low pressure, high level) / several vibration alarms inside compressor package.
8	
9	Availability of compressor trips (low low pressure, high high level, vibration trip in the compressor package)
10	
11	
12	

Action	The necessary actions for QA-K-8001A shut down are:

Interlock	LIT109 LL	Design Intent	Protection against low low level in compressor QA-K-8001A casing		
Initiators	LIT109 LL	P&ID	12212	Final elements	ESDV109 (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Emptying of compressor QA-K-8001A casing leading to more pressure to closed drain drum (#22), and release of flammable gas to cold vent stack			a	Failure open of LV108	0,10	1,00	1,00	1,00	1,00	1,00	1,00E-01		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									1,00E-01	1,00E-01	**1**
	ENVIRONMENTAL	F	1,00E-02									1,00E-01	1,00E-01	**1**
	ASSET	F	1,00E-02									1,00E-01	1,00E-01	**1**

NOTES

H	Release of gas and fire from cold vent stack. Minor impact to operators since the fire is located inside a fenced area (normally unmanned)
E	Release of gas and fire from cold vent stack. Limited impact; Dispersion of combustion fumes in case of fire
A	Loss of product, limited value. No effects to equpiment is expected in case of fire.
1	Maximum gas blow by from compressor casing will not cause overpressurization of QA-V-8008
2	
3	
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Action	N.A.

Interlock	LIT110 HH	Design Intent	Protection against high high level in compressor QA-K-8001A casing		
Initiators	LIT110 HH	P&ID	12212	Final elements	QA-K-8001A (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overfilling of compressor QA-K-8001A casing leading to potential mechanical damage to compressor			a	Failure closed of LV108	0,10	0,10	0,10	1,00	0,10	1,00	1,00E-04		
				b	Spurious closure of ESDV109	0,05	0,10	0,10	0,10	0,10	1,00	5,00E-06		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,05E-04	9,52E+00	**NC**
	ENVIRONMENTAL	D	1,00E-04									1,05E-03	9,52E-02	**1**
	ASSET	D	1,00E-04									1,05E-03	9,52E-02	**1**

NOTES

H	Damage to compressor internals leading to gas release to atmospher through secondary vent
E	Damage to compressor internals leading to gas release to atmospher through secondary vent
A	Mechanical damage of compressor and stop of production for long period + cost of repair. In early production, a spare is avalable with no loss of production. In later stage, failure will lead to half of production loss. Damage is assumed to be less than liquid carry over in suction line case.
1	
2	
3	
4	Event is expected only during startup or pressurized shutdown.
5	
6	
7	ESDV is equipped with limit switches with alarm in control room
8	Presence of compressor casing to reduce impact to people
9	High high vibration to shut down the compressor
10	
11	
12	

Action	The necessary actions for QA-K-8001A shut down are:

Interlock	TIT111 HH	Design Intent	Protection against high high temperature in discharge line from compressor casing (closed drain)				
Initiators	TIT111 HH	P&ID	12212		Final elements		ESDV109 (C)
Remarks							

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of compressor's casing draining line leading to More Temperature to Closed Drain and possible overheating.			a	Temperature More in compressor QA-K-8001A casing	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,00E-02	1,00E-01	**1**
	ENVIRONMENTAL	F	1,00E-02									1,00E-02	1,00E+00	**NC**
	ASSET	E	1,00E-03									1,00E-02	1,00E-01	**1**

NOTES

H	Release of flammable gas and jet fire. Possible permanent injury
E	Release of flammable gas and jet fire. Limited impact due combustion gas dispersion.
A	Mechanical damage of closed drain drain circuit. Need to repair. Damage of closed drain pump.
1	Design temperature of Closed Drain circuit QA-V-8008 is below the design temperature of the compressor QA-K-8001A/B/C/D
2	
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4	
5	
6	
7	Availability of alarm (lube oil high temperature, process gas high temperature)
8	
9	
10	
11	
12	

Action	The necessary actions for QA-K-8001A shut down are:

Interlock	TIT110 HH	Design Intent	Protection against high high temperature in compressor QA-K-8001A bearings				
Initiators	TIT110 HH	P&ID	12212		Final elements		QA-K-8001A (T)
Remarks							

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating to compressor bearing leading to compressor damage			a	Temperature More in compressor QA-K-8001A bearing due to loss of lube oil	0,10	1,00	0,10	0,10	1,00	1,00	1,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,00E-03	1,00E+00	**NC**
	ENVIRONMENTAL	E	1,00E-03									1,00E-03	1,00E+00	**NC**
	ASSET	D	1,00E-04									1,00E-03	1,00E-01	**1**

NOTES

H	Limited damage with possible reduced loss of containment. Potential for injuries.
E	Limited damage with possible reduced loss of containment. Limited impact to environment.
A	Mechanical damage of compressor and stop of production for short period + cost of repair. In early production, a spare is avalable with no loss of production. In later stage, failure will lead to half of production loss (5-7 days)
1	
2	
3	
4	
5	
6	Availability of interlock in lube oil circuit inside compressor package
7	Low pressure alarm in lube oil circuit inside compressor package
8	
9	
10	
11	
12	

Action	The necessary actions for QA-K-8001A shut down are:

Interlock	TIT113 LL	Design Intent	Protection against low low temperature in QA-E-8001A outlet		
Initiators	TIT113 LL	P&ID	12213	Final elements	ESD110A
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Increased gas subcooling leading to increased condensate production and possible hydrate formation			a	Failure of TIC107 putting to maximum speed QA-E-8001A	0,10	0,25	1,00	1,00	1,00	0,10	2,50E-03		
				b	Low flow of process gas	0,10	0,25	0,10	0,10	1,00	0,10	2,50E-05		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									2,53E-03	3,96E-01	**NC**
	ENVIRONMENTAL	E	1,00E-03									2,53E-03	3,96E-01	**NC**
	ASSET	C	1,00E-05									2,53E-03	3,96E-03	**2**

NOTES

H	Damage to compressor internals leading to gas release to atmospher through secondary vent
E	Significant leakage of flammable gas and fire. Dispersion of combustion fumes.
A	Mechanical damage of compressor and stop of production for long period + cost of repair. In early production, a spare is avalable with no loss of production. In later stage, failure will lead to half of production loss.
1	
2	
3	
4	The hydrate formation is expected only during the cold weather
5	
6	TIC107 with regulation of QA-E-8001A (b)
7	Low Flow alarm on FI102
8	
9	Vibration tripping the compressor
10	
11	
12	

Action	N.A.

Interlock	TIT108A_B_C HH	Design Intent	Protection against high high temperature in QA-E-8001A outlet		
Initiators	TIT108A_B_C HH	P&ID	12213	Final elements	QA-K-8001A (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	More Temperature in QA-V-8002A (#04A) leading to possibile mechanical damage to compressor discharge and eventually to pipeline.			a	Failure of air cooler QA-E-8001A	0,10	1,00	0,10	0,10	1,00	1,00	1,00E-03		
				b	Failure of TIC107 shutting down QA-E-8001A	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,10E-02	9,09E-03	**2**
	ENVIRONMENTAL	E	1,00E-03									1,10E-02	9,09E-02	**1**
	ASSET	D	1,00E-04									1,10E-02	9,09E-03	**2**

NOTES

H	Release of flammable gas and jet fire. Possible permanent injury
E	Release of flammable gas and jet fire. Limited impact due combustion gas dispersion.
A	Mechanical damage of compressor and stop of production for long period + cost of repair. In early production, a spare is available with no loss of production. In later stage, failure will lead to half of production loss (2 days shutdown)
1	
2	
3	
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5	
6	TIC107 with regulation of QA-E-8001A
7	High temperature alarm on TI103 / Status of air cooler (on/off)
8	
9	
10	
11	
12	

Action	The necessary actions for QA-K-8001A shut down are:

Interlock	VSHH102A/B/C HH	Design Intent	Protection against high high vibration of compressor's shaft		
Initiators	VSHH102A/B/C HH	P&ID	12213	Final elements	QA-K-8001A (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Excessive vibration leading to mechanical damage of air cooler fan			a	Condition for vibration	0,10	1,00	1,00	1,00	1,00	1,00	1,00E-01		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	G	1,00E-01									1,00E-01	1,00E+00	**NC**
	ENVIRONMENTAL	G	1,00E-01									1,00E-01	1,00E+00	**NC**
	ASSET	F	1,00E-02									1,00E-01	1,00E-01	**1**

NOTES

H	Damage to air cooler fan. No leakage is expected.
E	Damage to air cooler fan. No leakage is expected.
A	Damage to air cooler fan. No leakage is expected. Need to repair.
1	
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Action	

Interlock	LIT104A LL	Design Intent	Protection against low low level in QA-V-8002A		
Initiators	LIT104A LL	P&ID	12214	Final elements	ESDV 104 (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Gas blow by to the production separators in existing facilities leading to more pressure			a	Failure open of LV 105	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	G	1,00E-01									1,00E-02	1,00E+01	**NC**
	ENVIRONMENTAL	G	1,00E-01									1,00E-02	1,00E+01	**NC**
	ASSET	F	1,00E-02									1,00E-02	1,00E+00	**NC**

NOTES

H	No mechanical damage is expected. No impact to persons.
E	No mechanical damage is expected. No impact to environment.
A	Process upset in existing facility with possible unit shut down for a short period.
1	No mechanical damage is expected since down stream existing facilities design pressure is same as compressor pressure.
2	
3	
4	
5	
6	
7	LV-105 is equipped with limit switches with alarms.
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Action	N.A.

Interlock	LIT104B HH	Design Intent	Protection against high high level in QA-V-8002A		
Initiators	LIT104B HH	P&ID	12214	Final elements	ESDV 104 (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overfilling of QA-V-8002A leading to liquid carry over to main compressor unit discharge header and to existing export pipeline with possible hammering. Potential for limited damage due to hammering / corrosion			a	Spurious closure of ESDV 104	0,05	1,00	1,00	0,10	1,00	1,00	5,00E-03		
				b	Failure close of LV 105	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				c	Manual valves in the condensate outlet line of QA-V-8001A closed due to misoperation	0,05	1,00	1,00	0,10	1,00	1,00	5,00E-03		
				d	Spurious closure of ESDV017, ESDV018, ESDV019, ESDV020, ESDV021 in the existing facility	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				e								0,00E+00		
	HEALTH	F	1,00E-02									3,00E-02	3,33E-01	**NC**
	ENVIRONMENTAL	F	1,00E-02									3,00E-02	3,33E-01	**NC**
	ASSET	D	1,00E-04									3,00E-02	3,33E-03	**2**

NOTES

H	No damage is expected
E	No damage is expected
A	Possible localized damage to valves/instruments. Need for plant shut down and repair (expected not long term).
1	
2	
3	
4	
5	
6	
7	LIC 105 with high level alarm/ LV105 is equipped with limit switches (with alarm in DCS)
8	
9	
10	
11	
12	

Action	N.A.

Interlock	PDIT908 HH	Design Intent	Protection against pressurization at circuit start up		
Initiators	PDIT908	P&ID	12353	Final elements	ESDV032A
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible gas hammering in down stream piping leading to potential mechanical damage. Limited leakage and fire.			a	Incorrect opening of ESDV 032A during start up due to misoperation.	0,05	0,10	1,00	1,00	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									5,00E-03	2,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Limited leakage leading to fire. Possible for permenant injury.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of compressor circuit. Two days complete shutdown plus repairing of weak points (9 M$)
1	
2	
3	
4	Active only during start up
5	
6	
7	ESDV 031A is equipped with limit switches with alarm in DCS
8	
9	
10	
11	
12	

Action	N.A.

Interlock	PDIT909 HH	Design Intent	Protection against pressurization at circuit start up		
Initiators	PDIT909	P&ID	12353	Final elements	ESDV033A
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible gas hammering in down stream piping leading to potential mechanical damage. Limited leakage and fire.			a	Incorrect opening of ESDV 032A during start up due to misoperation.	0,05	0,10	1,00	1,00	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Limited leakage leading to fire. Possible for permenant injury.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of compressor circuit. Two days complete shutdown plus repairing of weak points (9 M$)
1	
2	
3	
4	Active only during start up
5	
6	
7	ESDV 031A is equipped with limit switches with alarm in DCS
8	
9	
10	
11	
12	

Action	N.A.

Interlock	LIT011A LL	Design Intent	Protection against low low level in Closed Drains Drum QA-V-8008		
Initiators	LIT011A LL	P&ID	12311-2	Final elements	P-8006A/B (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible cavitation of QA-P-8006A/B and QA-P-8007A/B leading to mechanical damage			a	Failure of LIC-012 putting in operation QA-P-8007A/B	0,10	1,00	1,00	0,10	0,10	1,00	1,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,00E-03	1,00E+00	**NC**
	ENVIRONMENTAL	F	1,00E-02									1,00E-02	1,00E+00	**NC**
	ASSET	E	1,00E-03									1,00E-02	1,00E-01	**1**

NOTES

H	Possible limited leakage of flammable substance from pump seal and fire. Possible injury
E	Possible limited leakage of flammable substance and fire. Minor effects
A	Possible damage and cost of repair. Availabily of spare pump.
1	
2	
3	
4	
5	
6	
7	Indication of status of pump QA-P-8006A/B
8	
9	Possibility to have a safe escape due to noise before pump damage.
10	PZA 066A/B in suction of QAP8007 A/B to stop the pump
11	
12	

Action	N.A.

Interlock	PIT066A/B LL	Design Intent	Protection against low low pressure in QA-P-8007 A/B suction		
Initiators	PIT066A/B LL	P&ID	12312	Final elements	QA-P-8007A/B (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Pump QA-P-8007A/B cavitation leading to possible mechanical damage			a	Blockage of pump QA-P-8007A/B suction strainer	0,10	1,00	1,00	1,00	0,10	0,10	1,00E-03		
				b	Level Less in QA-V-8008	0,01	1,00	1,00	1,00	0,10	0,10	1,00E-04		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,10E-03	9,09E-01	**NC**
	ENVIRONMENTAL	F	1,00E-02									1,10E-02	9,09E-01	**NC**
	ASSET	F	1,00E-02									1,10E-02	9,09E-01	**NC**

NOTES

H	Possible limited leakage of flammable substance from pump seal and fire. Possible injury
E	Possible limited leakage of flammable substance and fire. Minor effects
A	Possible damage and cost of repair. Availabily of spare pump.
1	
2	
3	Case (b) - Refer to LIT011LL analysis
4	Case (b) - for Demand rate refer to LIT011LL analysis
5	
6	
7	
8	
9	FZA-020A/B low low flow interlock to stop the pump QA-P-8007A/B
10	
11	
12	

Action	N.A.

Interlock	PIT929A/B HH	Design Intent	Protection against high high pressure in QA-P-8007 A/B discharge		
Initiators	PIT929A/B HH	P&ID	12312	Final elements	QA-P-8007A/B (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Increase of pressure up to pump shut-off leading to piping mechanical damage			a	Spurious closure of ESDV-008	0,10	1,00	0,10	1,00	1,00	0,01	1,00E-04		
				b	Spurious closure of XV-031A/B in pump discharge line	0,10	1,00	0,10	1,00	1,00	0,01	1,00E-04		
				c	Spurious closure of ESDV017, ESDV018, ESDV019, ESDV020, ESDV021 in the existing facility (refer to #04A)	0,40	1,00	0,10	1,00	1,00	0,01	4,00E-04		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									6,00E-04	1,67E-01	**NC**
	ENVIRONMENTAL	D	1,00E-04									6,00E-04	1,67E-01	**NC**
	ASSET	D	1,00E-04									6,00E-04	1,67E-01	**NC**

NOTES

H	Mechanical damage of pump discharge line with release and fire. Possible fatality.
E	Mechanical damage of pump discharge line with dispersion of combustion fumes.
A	Possible damage of closed drain system with stop of production for long period + cost of repair.
1	
2	
3	
4	
5	
6	Minimum flow line managed by control loop
7	
8	
9	PSV-930A/B designed for blocked outlet case
10	
11	
12	

Action	N.A.

Interlock	LIT001 LL	Design Intent	Protection against low low level in existing Closed Drain QA-T-3002		
Initiators	LIT001 LL	P&ID	12372	Final elements	PM-3016 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible cavitation of QA-PM-3016 leading to mechanical damage			a	Prolonged operation of QA-PM-3016 due to misoperation	0,05	1,00	1,00	0,10	0,10	1,00	5,00E-04		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									5,00E-04	2,00E+01	**NC**
	ENVIRONMENTAL	F	1,00E-02									5,00E-03	2,00E+00	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	No damage is expected
E	No damage is expected
A	Possible damage and cost of repair. Shut down of existing unit.(1 day)
1	
2	
3	
4	
5	
6	
7	Indication of status of pump QA-PM-3016
8	
9	Possibility to have a safe escape due to noise before pump damage.
10	
11	
12	

Action	N.A.

Interlock	LIT004 LL	Design Intent	Protection against low low level in existing Closed Drain QA-T-4002		
Initiators	LIT004 LL	P&ID	12373	Final elements	PM-4016 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible cavitation of QA-PM-4016 leading to mechanical damage			a	Prolonged operation of QA-PM-4016 due to misoperation	0,05	1,00	1,00	0,10	0,10	1,00	5,00E-04		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									5,00E-04	2,00E+01	**NC**
	ENVIRONMENTAL	F	1,00E-02									5,00E-03	2,00E+00	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	No damage is expected
E	No damage is expected
A	Possible damage and cost of repair. Shut down of existing unit.(1 day)
1	
2	
3	
4	
5	
6	
7	Indication of status of pump QA-PM-3016
8	
9	Possibility to have a safe escape due to noise before pump damage.
10	
11	
12	

Action	N.A.

Interlock	PDIT910_911 HH	Design Intent	Protection against gas		
Initiators	PDIT910_911 HH	P&ID	12353	Final elements	ESDV034A/35A
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible hammering in down stream piping leading to potential mechanical damage. Limited leakage and fire.			a	Incorrect opening of ESDV 034A/35A during start up due to misoperation.	0,05	0,10	1,00	1,00	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									5,00E-03	2,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Limited leakage leading to fire. Possible for permenant injury.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of compressor circuit. Two days complete shutdown plus repairing of weak points (9 M$)
1	
2	
3	
4	
5	Active only during start up
6	
7	ESDV 034A_35A is equipped with limit switches with alarm in DCS
8	
9	
10	
11	
12	

Action	N.A.

Interlock	PDIT912_913 HH	Design Intent	Protection against gas		
Initiators	PDIT912_913 HH	P&ID	12353	Final elements	ESDV036A/37A
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible hammering in down stream piping leading to potential mechanical damage. Limited leakage and fire.			a	Incorrect opening of ESDV 036A/37A during start up due to misoperation.	0,05	0,10	1,00	1,00	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									5,00E-03	2,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Limited leakage leading to fire. Possible for permenant injury.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of compressor circuit. Two days complete shutdown plus repairing of weak points (9 M$)
1	
2	
3	
4	
5	Active only during start up
6	
7	ESDV 036_37A is equipped with limit switches with alarm in DCS
8	
9	Assumed that 1/10 of times, the damage effectively occurs.
10	
11	
12	

Action	N.A.

Interlock	PIT924 HH	Design Intent	Protection against high high pressure in condensate header to QA-V-8005A		
Initiators	PIT924 HH	P&ID	12353	Final elements	ESDV-034A, ESDV 035A
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overpressurization of condensate suction header leading to mechanical damage			a	More pressure from upstream existing facility	0,10	1,00	1,00	0,10	1,00	0,01	1,00E-04		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									1,00E-04	1,00E-01	**1**
	ENVIRONMENTAL	E	1,00E-03									1,00E-04	1,00E+01	**NC**
	ASSET	D	1,00E-04									1,00E-04	1,00E+00	**NC**

NOTES

H	Significant leakage from main header leading to possible jet fire.possible to one fatality.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of condensate suction header and stop of production for one day + cost of repair.
1	
2	
3	
4	
5	
6	
7	High pressure alarm in suction header
8	
9	PSV006A in condensate header
10	
11	
12	

Action	N.A.

Interlock	PIT076A_B_C HH	Design Intent	Protection against high high pressure in condensate header to QA-V-8005A							
Initiators	PIT076A_B_C HH	P&ID	12366			Final elements		ESDV-026A/B (C)		
Remarks										

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Gas blow by from QA-V-8005A/B leading to overpressurization of degasser QA-V-4005 leading to mechanical damage.			a	Level Less interface in QA-V-8005A/B	0,10	1,00	0,10	0,10	1,00	1,00	1,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									1,00E-03	1,00E-02	**2**
	ENVIRONMENTAL	E	1,00E-03									1,00E-03	1,00E+00	**NC**
	ASSET	D	1,00E-04									1,00E-03	1,00E-01	**1**

NOTES

H	Mechanical damage leading to significant gas leakage and fire. Possible fatality
E	Significant leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Possible damage of degaser leading to loss of production (by half) plus cost of repair
1	
2	
3	Refer to LIT021A/B analysis
4	Demand rate due to low level in QA-V-8005A/B from LIT021A/B analysis
5	
6	Low low level trip LIT021LL in QA-V-8005A/B
7	Low level hydrocarbon phase alarm in QA-V-8005A/B
8	
9	
10	
11	
12	

Action	N.A.

Interlock	LIT002A/3A LL	Design Intent	Protection against low low level in condensate suction drum QA-V-8005A		
Initiators	LIT002A/3A LL	P&ID	12250-54	Final elements	ESDV001A/B (C) and QA-P-8003A/B/C (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Pump QA-P-8003A/B/C dry running leading to cavitation and possible mechanical damage.			a	Failure of LIC-001A setting at maximum speed of pump QA-P-8003A/B/C	0,10	1,00	0,10	0,10	0,10	1,00	1,00E-04		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,00E-04	1,00E+01	**NC**
	ENVIRONMENTAL	F	1,00E-02									1,00E-03	1,00E+01	**NC**
	ASSET	D	1,00E-04									1,00E-03	1,00E-01	**1**

NOTES

H	Possible limited leakage of flammable substance from pump seal and fire. Possible injury
E	Possible limited leakage of flammable substance and fire. Minor effects
A	Possible damage of two pumps (third pump is spare) and cost of repair. Spare pump. Possible reduction of production.(by half) in first period ,three pumps will be running and consequence will be total loss of production for two days.
1	
2	
3	
4	
5	
6	Low low flow interlock FZA-019A/B/C to stop the pump QA-P-8003A/B/C
7	Indication of status of pump QA-P-3003A/B/C
8	
9	Possibility to have a safe escape due to noise before pump damage.
10	
11	
12	

Action	N.A.

Interlock	LIT002B/3B HH	Design Intent	Protection against high high level in condensate suction drum QA-V-8005A/B		
Initiators	LIT002B/3B HH	P&ID	12250 / 54	Final elements	ESDV011A/B (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overfilling of QA-V-8005A leading to condensate carry-over to Fuel gas circuit (#13) and More Pressure in QA-V-8005A. Condensate carry-over to compressor QA-K-8003A with possible mechanical damage			a	Spurious closure of ESDV-001A	0,05	1,00	1,00	0,10	1,00	1,00	5,00E-03		
				b	Pump QA-P-8003A/B/C failure	0,20	1,00	0,10	0,10	1,00	1,00	2,00E-03		
				c	Spurious closure of ESDV-014	0,05	1,00	1,00	0,10	1,00	1,00	5,00E-03		
				d	Failure of LIC-001A stopping pump QA-P-8003A/B/C	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				e								0,00E+00		
	HEALTH	E	1,00E-03									2,20E-02	4,55E-02	**1**
	ENVIRONMENTAL	F	1,00E-02									2,20E-02	4,55E-01	**NC**
	ASSET	D	1,00E-04									2,20E-02	4,55E-03	**2**

NOTES

H	Damage to Flash gas compressor with limited release. Possible fire and injuries.
E	Damage to Flash gas compressor with limited release. Limited dispersion in atmosphere
A	Damage to flash gas compressor, need for repair and limited loss of production. Spare flash gas compressor.in case of liquid carry over to flare header , possibility of total plant shutdown.
1	
2	
3	
4	
5	
6	FZA-011A low low flow activate the stand-by pump
7	High Level alarm in LIC-001A_B/ Indication of pump status in DCS
8	
9	
10	
11	
12	

Action	N.A.

Interlock	PIT002A/B HH	Design Intent	Protection against high high pressure in condensate suction drum A/B		
Initiators	PIT002A/B HH	P&ID	12250 / 54	Final elements	ESDV011A/B (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overpressurization of QA-V-8005A and mechanical damage.			a	More Level in QA-V-8005A	0,02	1,00	0,10	1,00	1,00	0,01	2,20E-05		
				b	Spurious closure of ESDV012A	0,05	1,00	1,00	1,00	1,00	0,01	5,00E-04		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									5,22E-04	1,92E-02	**1**
	ENVIRONMENTAL	D	1,00E-04									5,22E-04	1,92E-01	**NC**
	ASSET	B	1,00E-06									5,22E-04	1,92E-03	**2**

NOTES

H	Mechanical damage and release. Possible for fire. Possible for one fatalities since the condensate drum is installed 9
E	Mechanical damage and release. Localized impact to environment
A	Mechanical damage of QA-V-8005A + cost of repair. Availability of spare suction condensate drum QA-V-8005B, which assumed to be involved in fire . Potential for damage to plant and prolonged shut down.
1	
2	
3	Refer to LIT002BHH analysis.
4	The demand rate is the calculate intermediate likelihood of more level in QA-V-8005A (refer to LIT002HH analysis).
5	
6	High high level trip.
7	High pressure alarm in PIC003
8	
9	PSV007A/B in QA-V-8005A/B sized for this case. PSV006A/B in condensate line from existing facility
10	
11	
12	

Action	N.A.

Interlock	LIT021A/B LL	Design Intent	Protection against high high interface level in condensate suction drum QA-V-8005A ONLY ALARM??		
Initiators	LIT021A/B LL	P&ID	12250	Final elements	ESDV026B (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possbile condensate carry over (flashing) to the degasser leading to Pressure More in the Degasser and possible mechanical damage. More Flow of gas to cold vent. Possible fire.			a	Failure open of LV-016A	0,10	1,00	1,00	0,10	1,00	0,01	1,00E-04		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									1,00E-04	1,00E-01	**1**
	ENVIRONMENTAL	E	1,00E-03									1,00E-04	1,00E+01	**NC**
	ASSET	D	1,00E-04									1,00E-04	1,00E+00	**NC**

NOTES

H	Mechanical damage leading to significant gas leakage and fire. Possible fatality
E	Significant leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Possible damage of degaser leading to loss of production (by half) plus cost of repair
1	
2	
3	
4	
5	
6	
7	Refer to action
8	
9	PIT076A_B_C trip in condensate discharge line (Classified as SIL 2)
10	
11	
12	

Action	Install a limit switch in LV016A with alarm in control room in order to provide additional alarm and reduce the SIL level by one.

Interlock	VSHH102A/B/C HH	Design Intent	Protection against high high vibration of compressor's shaft		
Initiators	VSHH102A/B/C HH	P&ID	12213	Final elements	QA-K-8001A (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Excessive vibration leading to mechanical damage of pump QA-V-8003A/B/C			a	Condition for vibration (cavitation, blocked outlet)	0,10	1,00	0,10	0,10	1,00	1,00	1,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,00E-03	1,00E+00	**NC**
	ENVIRONMENTAL	F	1,00E-02									1,00E-03	1,00E+01	**NC**
	ASSET	D	1,00E-04									1,00E-03	1,00E-01	**1**

NOTES

H	Possible limited leakage of flammable substance from pump seal and fire. Possible injury
E	Possible limited leakage of flammable substance and fire. Minor effects
A	Possible damage and cost of repair. Availabily of spare pump.
1	
2	
3	
4	
5	
6	Availability of pump trip system for different deviation (low low flow, high high pressure discharge)
7	Availability of alarm for different deviation (low flow, high pressure discharge)
8	
9	
10	
11	
12	

Action	The necessary actions for QA-K-8001A shut down are:

Interlock	PIT918A/B/C HH	Design Intent	Protection against high high pressure in QA-P-8003A/B/C		
Initiators	PIT918A/B/C HH	P&ID	12251	Final elements	QA-P-8003A/B/C (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Increase of pressure up to pump shut-off leading to piping mechanical damage and release of flammable substance.			a	Spurious closure of ESDV-014	0,05	1,00	0,10	0,10	1,00	0,01	5,00E-06		
				b	Spurious closure of XV-027A/B/C in pump discharge line	0,05	1,00	0,10	0,10	1,00	0,01	5,00E-06		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									1,00E-05	1,00E+00	**NC**
	ENVIRONMENTAL	D	1,00E-04									1,00E-05	1,00E+01	**NC**
	ASSET	D	1,00E-04									1,00E-05	1,00E+01	**NC**

NOTES

H	Significant leakage and fire. Possibility of multiple fatalities
E	Significant leakage and fire. Dispersion of combustion fumes
A	Possible damage of two pumps (third pump is spare) and cost of repair. Spare pump. Possible reduction of production.(by half) in first period ,three pumps will be running and consequence will be total loss of production for two days.
1	
2	
3	
4	
5	
6	Minimum flow line regulated by FIC001A/B/C
7	Low flow alarm and trip FZA019A/B/C
8	
9	PSV-093A/B/C designed for blocked outlet case / Low low flow interlock FZA-019A/B/C to stop the pump QA-P-8003A/B/C
10	
11	
12	

Action	N.A.

Interlock	FIT019A/B/C LL	Design Intent	Protection against low low flow to QA-P-8003A/B/C		
Initiators	FIT019A/B/C LL	P&ID	12251	Final elements	QA-P-8003A/B/C (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Pump QA-P-8003A/B/C cavitation/blocked outlet leading to possible mechanical damage			a	Spurious closure of ESDV-001A	0,10	1,00	1,00	0,10	0,10	0,10	1,00E-04		
				b	Spurious closure of ESDV-014	0,10	1,00	1,00	0,10	0,10	0,10	1,00E-04		
				c	Spurious closure of XV-027A/B/C in pump discharge line	0,10	1,00	1,00	0,10	0,10	0,10	1,00E-04		
				d	Failure of LIC-001A setting at maximum speed of pump QA-P-8003A/B/C	0,10	1,00	1,00	0,10	0,10	0,10	1,00E-04		
				e								0,00E+00		
	HEALTH	D	1,00E-04									4,00E-04	2,50E-01	**NC**
	ENVIRONMENTAL	F	1,00E-02									4,00E-03	2,50E+00	**NC**
	ASSET	E	1,00E-03									4,00E-03	2,50E-01	**NC**

NOTES

H	Possible limited leakage of flammable substance from pump seal and fire. Possible injury
E	Possible limited leakage of flammable substance and fire. Minor effects
A	Possible damage and cost of repair. Availabily of spare pump.
1	
2	
3	
4	
5	
6	
7	ESDVs valves provided with limit switches and alarms / Indication of status of pump QA-P-3003A/B/C
8	Possibility to have a safe escape due to noise before pump damage.
9	Vibration trip / high pressure trip in discharge
10	
11	
12	

Action	N.A.

Interlock	PIT0062 HH	Design Intent	Protection against high high pressure in HP/LP interface with flash gas compressors				
Initiators	PIT0062 HH	P&ID	12262		Final elements		ESDV-013A/B (C)
Remarks							

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Back flow of process gas from QA-K-8001A suction to QA-K-8003A leading to Pressure More and mechanical damage			a	Stop of compressor QA-K-8003A	0,10	1,00	0,10	0,10	1,00	0,01	1,00E-05		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									1,00E-05	1,00E+00	**NC**
	ENVIRONMENTAL	E	1,00E-03									1,00E-05	1,00E+02	**NC**
	ASSET	D	1,00E-04									1,00E-05	1,00E+01	**NC**

NOTES

H	Release of flammable gas and fire. Possible fatality.
E	Release of flammable gas and fire. Dispersion of combustion fumes
A	Damage to compressor. Cost of repair. Limited production losses due to availability of spare compressor.
1	
2	
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5	
6	Double check valve (dissimilar) on discharge of QA-K-8003A/B.
7	High pressure alarm on PI-072
8	
9	PSV026A on discharge line of QA-K-8003A/B sized for reverse flow scenario.
10	
11	
12	

Action	N.A.

Interlock	PIT071A/B LL	Design Intent	Protection against low low pressure in QA-K-8003A/B suction		
Initiators	PIT071A/B LL	P&ID	12261 / 62	Final elements	QA-K-8003A/B (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Compressor QA-K-8003A surge			a	Spurious closure of ESDV013	0,10	1,00	0,10	0,10	1,00	1,00	1,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,00E-03	1,00E+00	**NC**
	ENVIRONMENTAL	E	1,00E-03									1,00E-03	1,00E+00	**NC**
	ASSET	E	1,00E-03									1,00E-03	1,00E+00	**NC**

NOTES

H	Damage to compressor internals leading to possible limited gas release to atmosphere and jet fire
E	Significant leakage of flammable gas and fire. Dispersion of combustion fumes.In caseof damage of spare compressor
A	Damage to compressor. Cost of repair. Limited production losses due to availability of spare compressor.In caseof damage of spare compressor due to fire, possible increase of flaring.
1	
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6	VT001A/B high high vibration trip
7	Low flow alarm on FI003A, Low pressure alarm on PI070A
8	
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Action	N.A.

Interlock	PIT021A/B HH	Design Intent	Protection against high high pressure in QA-K-8003A/B discharge		
Initiators	PIT021A/B HH	P&ID	12261 / 62	Final elements	QA-K-8003A/B (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overpressurization of Compressor QA-K-8003A discharge line leading to mechanical damage.			a	Spurious closure of ESDV013A/B in discharge line of QA-K-8003A/B	0,10	1,00	1,00	0,10	1,00	0,01	1,00E-04		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									1,00E-04	1,00E-01	**1**
	ENVIRONMENTAL	E	1,00E-03									1,00E-04	1,00E+01	**NC**
	ASSET	E	1,00E-03									1,00E-04	1,00E+01	**NC**

NOTES

H	Release of flammable gas and fire. Possible one fatality.
E	Release of flammable gas and fire. Dispersion of combustion fumes
A	Damage to compressor. Cost of repair. Limited production losses due to availability of spare compressor.
1	
2	
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7	High pressure alarm PIT020A/B
8	
9	PSV-022A sized for blocked discharge.
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Action	N.A.

Interlock	TIT004A/B HH	Design Intent	Protection against high high temperature in QA-K-8003A/B outlet		
Initiators	TIT004A/B HH	P&ID	12261 / 61	Final elements	QA-K-8003A/B (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Increase of compressor rate leading to overheating of discharge line. Possible mechanical damage and release.			a	Flow Less in suction of compressor	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,00E-02	1,00E-01	**1**
	ENVIRONMENTAL	F	1,00E-02									1,00E-02	1,00E+00	**NC**
	ASSET	E	1,00E-03									1,00E-02	1,00E-01	**1**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Damage to compressor. Cost of repair. Limited production losses due to availability of spare compressor.
1	
2	
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6	High temperature alarm on TI003A
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Action	The necessary actions for QA-K-8001A shut down are:

Interlock	TIT002A/B HH	Design Intent	Protection against high high temperature in compressor QA-K-8003A/B bearings				
Initiators	TIT002A/B HH	P&ID	12261 / 62		Final elements		QA-K-8003A/B (T)
Remarks							

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating to compressor bearing leading to compressor QA-K-8003A/B damage			a	Temperature More in compressor QA-K-8003A/B bearing due to loss of lube oil	1,00	1,00	1,00	1,00	1,00	1,00	1,00E+00		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,00E+00	1,00E-03	**3**
	ENVIRONMENTAL	F	1,00E-02									1,00E+00	1,00E-02	**2**
	ASSET	E	1,00E-03									1,00E+00	1,00E-03	**3**

NOTES

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Action	The SIF shall be analysed with flash gas compressor vendor

Interlock	VSHH001A/B HH	Design Intent	Protection against high high vibration of compressor's shaft QA-K-8003A/B		
Initiators	VSHH001A/B HH	P&ID	12261 / 62	Final elements	QA-K-8003A/B (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Excessive vibration leading to mechanical damage of compressor's shaft.			a	Condition for vibration (surge, liquid carry over)	1,00	1,00	1,00	1,00	1,00	1,00	1,00E+00		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	E	1,00E-03									1,00E+00	1,00E-03	**3**
	ENVIRONMENTAL	F	1,00E-02									1,00E+00	1,00E-02	**2**
	ASSET	E	1,00E-03									1,00E+00	1,00E-03	**3**

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Action	The SIF shall be analysed with flash gas compressor vendor

Interlock	PDIT028 HH	Design Intent	Protection against pressurization at circuit start up						
Initiators	PDIT028 HH	P&ID	12302			Final elements		ESDV002A	
Initiators									

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible gas hammering in down stream piping leading to potential mechanical damage. Limited leakage and fire.			a	Incorrect opening of ESDV 002A during start up due to misoperation.	0,05	0,10	1,00	1,00	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									5,00E-03	2,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Limited leakage leading to fire. Possible for permenant injury.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of fuel gas circuit. Two days complete shutdown plus repairing of weak points (9 M$)
1	
2	
3	
4	
5	Active only during start up
6	
7	ESDV 002A is equipped with limit switches with alarm in DCS
8	
9	
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11	
12	

Action	N.A.

Interlock	PDIT035 HH	Design Intent	Protection against pressurization at circuit start up							
Initiators	PDIT035 HH	P&ID	12303-1			Final elements		ESDV004A		
Initiators										

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible gas hammering in down stream piping leading to potential mechanical damage. Limited leakage and fire.			a	Incorrect opening of ESDV 004A during start up due to misoperation.	0,05	0,10	1,00	1,00	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									5,00E-03	2,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Limited leakage leading to fire. Possible for permenant injury.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of fuel gas circuit. Two days complete shutdown plus repairing of weak points (9 M$)
1	
2	
3	
4	
5	Active only during start up
6	
7	ESDV 004A is equipped with limit switches with alarm in DCS
8	
9	Assumed that 1/10 of times, the damage effectively occurs.
10	
11	
12	

Action	N.A.

Interlock	PDIT099 HH	Design Intent	Protection against pressurization at circuit start up		
Initiators	PDIT099 HH	P&ID	12354	Final elements	ESDV010A
Initiators					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible gas hammering in down stream piping leading to potential mechanical damage. Limited leakage and fire.			a	Incorrect opening of ESDV 010A during start up due to misoperation.	0,05	0,10	1,00	1,00	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									5,00E-03	2,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Limited leakage leading to fire. Possible for permenant injury.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of fuel gas circuit. Two days complete shutdown plus repairing of weak points (9 M$)
1	
2	
3	
4	
5	Active only during start up
6	
7	ESDV 010A is equipped with limit switches with alarm in DCS
8	
9	Assumed that 1/10 of times, the damage effectively occurs.
10	
11	
12	

Action	N.A.

Interlock	PDIT925 HH	Design Intent	Protection against pressurization at circuit start up						
Initiators	PDIT925 HH	P&ID	12368			Final elements		ESDV028A	
Initiators									

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Possible gas hammering in down stream piping leading to potential mechanical damage. Limited leakage and fire.			a	Incorrect opening of ESDV 028A during start up due to misoperation.	0,05	0,10	1,00	1,00	1,00	1,00	5,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									5,00E-03	2,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									5,00E-03	2,00E-01	**NC**
	ASSET	D	1,00E-04									5,00E-03	2,00E-02	**1**

NOTES

H	Limited leakage leading to fire. Possible for permenant injury.
E	Limited leakage leading to fire; potential for combustion fumes dispersion due to fire
A	Mechanical damage of fuel gas circuit. Two days complete shutdown plus repairing of weak points (9 M$)
1	
2	
3	
4	
5	Active only during start up
6	
7	ESDV 028A is equipped with limit switches with alarm in DCS
8	
9	Assumed that 1/10 of times, the damage effectively occurs.
10	
11	
12	

Action	N.A.

Interlock	TIT007 HH	Design Intent	Protection against high high temperature in QA-E-8002 outlet				
Initiators	TIT007 HH	P&ID	12302		Final elements		QA-E-8002 (T)
Remarks							

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8002 leading to mechanical damage			a	Failure of TDIC008 putting to maximum power QA-E-8002	0,10	1,00	1,00	1,00	1,00	0,01	1,00E-03		
				b	Spurious closure of ESDV002A in inlet line of QA-E-8002	0,05	1,00	0,10	0,10	1,00	0,01	5,00E-06		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,01E-03	9,95E-02	**1**
	ENVIRONMENTAL	F	1,00E-02									1,01E-03	9,95E+00	**NC**
	ASSET	E	1,00E-03									1,01E-03	9,95E-01	**NC**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair.
1	
2	
3	
4	
5	
6	TDIC008 with regulation of QA-E-8002
7	High temperature alarm on TDIC008
8	
9	TZA007 high high temperature interlock to shut down electrical heating on QA-E-8002 (classified as SIL2) / FZA026B LL to shutdown electrical heating on QA-E-8002.
10	
11	
12	

Action	

Interlock	TIT005 HH	Design Intent	Protection against high high temperature in QA-E-8002		
Initiators	TIT005 HH	P&ID	12302	Final elements	QA-E-8002 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8002 leading to mechanical damage			a	Failure of TDIC008 putting to maximum power QA-E-8002	0,10	1,00	1,00	1,00	1,00	0,10	1,00E-02		
				b	Spurious closure of ESDV002A in inlet line of QA-E-8002	0,05	1,00	0,10	0,10	1,00	0,10	5,00E-05		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,01E-02	9,95E-03	**2**
	ENVIRONMENTAL	F	1,00E-02									1,01E-02	9,95E-01	**NC**
	ASSET	E	1,00E-03									1,01E-02	9,95E-02	**1**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair.
1	
2	
3	
4	
5	
6	TDIC008 with regulation of QA-E-8002
7	High temperature alarm on TDIC008
8	
9	TZA005 high high temperature interlock to shut down electrical heating on QA-E-8002
10	
11	
12	

Action	

Interlock	FIT026 LL	Design Intent	Protection against high high temperature in QA-E-8002		
Initiators	FIT026 LL	P&ID	12302	Final elements	QA-E-8002 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8002 leading to mechanical damage			a	Spurious closure of ESDV002A in inlet line of QA-E-8002	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,00E-03	1,00E-01	**1**
	ENVIRONMENTAL	F	1,00E-02									1,00E-03	1,00E+01	**NC**
	ASSET	E	1,00E-03									1,00E-03	1,00E+00	**NC**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair.
1	
2	
3	Assumed for no flow cases
4	
5	
6	TDIC008 with regulation of QA-E-8002
7	
8	
9	TZA005 high high temperature interlock to shut down electrical heating on QA-E-8002
10	
11	
12	

Action	

Interlock	TIT011A/B HH	Design Intent	Protection against high high temperature in QA-E-8003A/B outlet		
Initiators	TIT011A/B HH	P&ID	12303-01/02	Final elements	QA-E-8002 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8003A/B leading to mechanical damage			a	Failure of TDIC012A/B putting to maximum power QA-E-8003A/B	0,10	1,00	1,00	1,00	1,00	0,01	1,00E-03		
				b	Spurious closure of ESDV004A in inlet line of QA-E-8003A/B	0,05	1,00	0,10	0,10	1,00	0,01	5,00E-06		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,01E-03	9,95E-02	**1**
	ENVIRONMENTAL	F	1,00E-02									1,01E-03	9,95E+00	**NC**
	ASSET	E	1,00E-03									1,01E-03	9,95E-01	**NC**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair.
1	
2	
3	
4	
5	
6	TDIC012A/B with regulation of QA-E-8003A/B
7	High temperature alarm on TDIC012A/B
8	
9	TZA009A/B high high temperature interlock to shut down electrical heating on QA-E-8003A/B (classified as SIL2) / FZA027B LL to shutdown electrical heating on QA-E-8003A/B.
10	
11	
12	

Action	

Interlock	TIT009A/B HH	Design Intent	Protection against high high temperature in QA-E-8003A/B outlet		
Initiators	TIT009A/B HH	P&ID	12303-01/02	Final elements	QA-E-8002 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8003A/B leading to mechanical damage			a	Failure of TDIC012A/B putting to maximum power QA-E-8003A/B	0,10	1,00	1,00	1,00	1,00	0,10	1,00E-02		
				b	Spurious closure of ESDV004A in inlet line of QA-E-8003A/B	0,05	1,00	0,10	0,10	1,00	0,10	5,00E-05		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,01E-02	9,95E-03	**2**
	ENVIRONMENTAL	F	1,00E-02									1,01E-02	9,95E-01	**NC**
	ASSET	E	1,00E-03									1,01E-02	9,95E-02	**1**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair.
1	
2	
3	
4	
5	
6	TDIC012A/B with regulation of QA-E-8003A/B
7	High temperature alarm on TDIC012A/B
8	
9	TZA009A/B high high temperature interlock to shut down electrical heating on QA-E-8003A/B
10	
11	
12	

Action	

Interlock	FIT027 LL	Design Intent	Protection against high high temperature in QA-E-8002		
Initiators	FIT027 LL	P&ID	12303-01/02	Final elements	QA-E-8002 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8002 leading to mechanical damage			a	Spurious closure of ESDV004A in inlet line of QA-E-8003A/B	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,00E-03	1,00E-01	**1**
	ENVIRONMENTAL	F	1,00E-02									1,00E-03	1,00E+01	**NC**
	ASSET	E	1,00E-03									1,00E-03	1,00E+00	**NC**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair.
1	
2	
3	
4	Assumed for no flow the failure of two possible ESDV
5	
6	TDIC012A/B with regulation of QA-E-8003A/B
7	
8	
9	TZA011A/B high high temperature interlock to shut down electrical heating on QA-E-8003A/B
10	
11	
12	

Action	

Interlock	LIT005 LL	Design Intent	Protection against low low level in QA-V-8006 A leading to gas blow by to QA-V-8008		
Initiators	LIT005 LL	P&ID	12305	Final elements	ESDV 005
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Gas blow by to the Closed Drain drum QA-V-8008 (#21) leading to More Pressure in QA-V-8008 and more gas to cold vent; possible ignition.			a	Failure open of LV 106	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									1,00E-02	1,00E+00	**NC**
	ENVIRONMENTAL	F	1,00E-02									1,00E-02	1,00E+00	**NC**
	ASSET	E	1,00E-03									1,00E-02	1,00E-01	**1**

NOTES

H	Release of flammable gas through cold vent. Possible fire. Minor impact to operators since the fire is located inside a fenced area (normally unmanned)
E	Limited impact; Dispersion of combustion fumes in case of fire
A	Limited impact ,possible repair of flame arrestor and cold vent piping ,complete plant shutdown for 1 day for maintenance plus the cost of repair.
1	Overpressure case is not expected due to proper design of cold vent (Refer to HAZOP action #70)
2	
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4	
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6	
7	LV106 is equipped with limit switches with alarm
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Action	N.A.

Interlock	LIT005 HH	Design Intent	Protection against low low level in QA-V-8006 A leading to gas blow by to QA-V-8008				
Initiators	LIT005 HH	P&ID	12305		Final elements		ESDVs in fuel gas inlet (C&ED 13/18)
Remarks							

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overfilling of QA-V-8006 leading to liquid carry over to QA-E-8005A/B with possible damage to heatesr/burners of turbine			a	Spurious closure of ESDV005	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				b	Failure close of LV 106	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	G	1,00E-01									2,00E-02	5,00E+00	**NC**
	ENVIRONMENTAL	G	1,00E-01									2,00E-02	5,00E+00	**NC**
	ASSET	D	1,00E-04									2,00E-02	5,00E-03	**2**

NOTES

H	Possible damage of QA-E-8005A/B and to gas turbine burners; no leakage is expected.
E	Possible damage of QA-E-8005A/B and to gas turbine burners; no leakage is expected.
A	Possible damage of QA-E-8005A/B and to gas turbine burners; availability of spare QA-E-8005A/B. Possibile short term shut down for entire plant for one day.
1	
2	
3	
4	
5	
6	
7	LV106 is equipped with limit switches with alarm/ ESDV005 is equipped with limit switches with alarm
8	
9	
10	
11	
12	

Action	N.A.

Interlock	FIT004 LL	Design Intent	Protection against high high temperature in QA-E-8002		
Initiators	FIT004 LL	P&ID	12305	Final elements	QA-E-8005A/B (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8005A/B leading to mechanical damage			a	Failure close of PV043A in inlet line of fuel gas	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				b	Blockage of QA-S-8001A/B	0,10	1,00	0,10	0,10	1,00	0,10	1,00E-04		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,10E-03	9,09E-02	**1**
	ENVIRONMENTAL	F	1,00E-02									1,10E-03	9,09E+00	**NC**
	ASSET	E	1,00E-03									1,10E-03	9,09E-01	**NC**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair. Spare heater
1	
2	
3	
4	
5	
6	TDIC020A/B with regulation of QA-E-8005A/B
7	High temperature alarm on TDIC020A/B
8	
9	TZA019A/B high high temperature interlock to shut down electrical heating on QA-E-8005A/B
10	
11	
12	

Action	

Interlock	PIT044A HH	Design Intent	Protection against high high pressure in QA-V-8006		
Initiators	PIT044A HH	P&ID	12305	Final elements	ESDV003-004A/B
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overpressurization of QA-V-8006 leading to mechanical damage and release			a	Failure open of PV043A in inlet line of QA-V-8006	0,10	1,00	0,10	1,00	1,00	0,01	1,00E-04		
				b	Failure open of PV003B in inlet line of QA-V-8006	0,10	1,00	0,10	1,00	1,00	0,01	1,00E-04		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									2,00E-04	5,00E-02	**1**
	ENVIRONMENTAL	E	1,00E-03									2,00E-04	5,00E+00	**NC**
	ASSET	B	1,00E-06									2,00E-04	5,00E-03	**2**

NOTES

H	Possibility of significant release of flammable gas. Potential for fatality
E	Possibility of significant release of flammable gas and combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for long period for all compressor train + cost of repair.higher consumption of Diesel fuel for excisting power generator leading to increase of cost
1	
2	
3	
4	
5	
6	PIC052 opening PV052 to flare
7	
8	
9	PSV097A/B in inlet line of QA-V-8006 sized for control failure scenario
10	
11	
12	

Action	

Interlock	PIT044B LL	Design Intent	Protection against low low pressure in QA-V-8006		
Initiators	PIT044B LL	P&ID	12305	Final elements	ESDV003-004A
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Pressure Less in this node leading to possible gas turbine shut down and consequent production losses			a	Failure close of PV043A during normal operation.	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	G	1,00E-01									1,00E-02	1,00E+01	**NC**
	ENVIRONMENTAL	G	1,00E-01									1,00E-02	1,00E+01	**NC**
	ASSET	G	1,00E-01									1,00E-02	1,00E+01	**NC**

NOTES

H	No difference between uncontrolled and controlled shut down
E	No difference between uncontrolled and controlled shut down
A	No difference between uncontrolled and controlled shut down
1	
2	
3	
4	
5	
6	
7	Low flow alarm in FI004B
8	
9	
10	
11	
12	

Action	

Interlock	PITXXXA HH	Design Intent	Protection against high high pressure in existing power generation		
Initiators	PITXXXA HH	P&ID	12305	Final elements	ESDVXXX
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Increase of pressure in existing power generator leading to unexpected complete shut down of site (gas plant and oil plant)			a	Failure open of PV904 in inlet line of existing power generation	0,10	1,00	1,00	1,00	1,00	1,00	1,00E-01		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									1,00E-01	1,00E-01	**1**
	ENVIRONMENTAL	F	1,00E-02									1,00E-01	1,00E-01	**1**
	ASSET	E	1,00E-03									1,00E-01	1,00E-02	**2**

NOTES

H	No impact on persons.
E	No impact on environment
A	Unexpected complete shut down of site (gas plant and oil plant) for one day. Assumed a lower impact on asset due to fact that there is no impact on safety and environment
1	ESDVXXX is installed in line to existing power generation.(upstream PV904), Refer to HAZOP action # 54
2	
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4	
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Action	Team agrees in the installation of 2 oo 3 voting for the initiators of the present SIF in order to consider acceptable the reduction of Asset Integrity Level of the SIF from AIL3 to AIL2.

Interlock	TIT022A/B HH	Design Intent	Protection against high high temperature in QA-E-8005A/B outlet		
Initiators	TIT022A/B HH	P&ID	12307-1	Final elements	QA-E-8005A/B (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8005A/B leading to mechanical damage			a	Failure of TDIC020A/B putting to maximum power QA-E-8003A/B	0,10	1,00	1,00	1,00	1,00	0,01	1,00E-03		
				b	Failure close of PV043A in inlet line of fuel gas	0,05	1,00	0,10	0,10	1,00	0,01	5,00E-06		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,01E-03	9,95E-02	**1**
	ENVIRONMENTAL	F	1,00E-02									1,01E-03	9,95E+00	**NC**
	ASSET	E	1,00E-03									1,01E-03	9,95E-01	**NC**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair.
1	
2	
3	
4	
5	
6	TDIC020A/B with regulation of QA-E-8005A/B
7	High temperature alarm on TDIC020A/B
8	
9	TZA019A/B high high temperature interlock to shut down electrical heating on QA-E-8005A/B (classified as SIL2) / FZA004 LL to shutdown electrical heating on QA-E-8005A/B.
10	
11	
12	

Action	

Interlock	TIT019A/B HH	Design Intent	Protection against high high temperature in QA-E-8005A/B outlet		
Initiators	TIT019A/B HH	P&ID	12307-1	Final elements	QA-E-8005A/B (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8005A/B leading to mechanical damage			a	Failure of TDIC020A/B putting to maximum power QA-E-8003A/B	0,10	1,00	1,00	1,00	1,00	0,10	1,00E-02		
				b	Failure close of PV043A in inlet line of fuel gas	0,05	1,00	0,10	0,10	1,00	0,10	5,00E-05		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,01E-02	9,95E-03	**2**
	ENVIRONMENTAL	F	1,00E-02									1,01E-02	9,95E-01	**NC**
	ASSET	E	1,00E-03									1,01E-02	9,95E-02	**1**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair.
1	
2	
3	
4	
5	
6	TDIC020A/B with regulation of QA-E-8005A/B
7	High temperature alarm on TDIC020A/B
8	
9	TZA022A/B high high temperature interlock to shut down electrical heating on QA-E-8005A/B
10	
11	
12	

Action	

Interlock	TDIT034 LL	Design Intent	Protection against low low temperature in QA-E-8001A outlet		
Initiators	TDIT034 LL	P&ID	12307-1	Final elements	QA-K-8001 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Temperature Less in fuel gas to gas turbine with possible condensation and excess of firing with mechanical damage of burners			a	Failure of TDIC048A/B shutting down QA-E-8005A/B	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	G	1,00E-01									1,00E-02	1,00E+01	**NC**
	ENVIRONMENTAL	G	1,00E-01									1,00E-02	1,00E+01	**NC**
	ASSET	D	1,00E-04									1,00E-02	1,00E-02	**2**

NOTES

H	Limited damage to turbine burners. No impact to personnel.
E	Limited damage to turbine burners. No impact to environment.
A	Possible stop of compressor trains for maintenance for 2 days.
1	
2	
3	
4	
5	
6	
7	TZA022 low temperature alarm
8	
9	
10	
11	
12	SIL value to be reviewed upon SOLAR reply on HAZOP action # 53

Action	N.A.

Interlock	LIT008A LL	Design Intent	Protection against low low level in QA-V-8007 A leading to gas blow by to QA-V-8008								
Initiators	LIT008A LL	P&ID	12308-2			Final elements		ESDV 008			
Remarks											

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Gas blow by to the Closed Drain drum QA-V-8008 leading to More Pressure in QA-V-8008 and more gas to cold vent; possible ignition.			a	Failure open of LV 009	0,10	1,00	1,00	0,10	1,00	1,00	1,00E-02		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									1,00E-02	1,00E+00	**NC**
	ENVIRONMENTAL	F	1,00E-02									1,00E-02	1,00E+00	**NC**
	ASSET	E	1,00E-03									1,00E-02	1,00E-01	**1**

NOTES

H	Release of flammable gas through cold vent. Possible fire. Minor impact to operators since the fire is located inside a fenced area (normally unmanned)
E	Limited impact; Dispersion of combustion fumes in case of fire
A	Limited impact ,possible repair of flame arrestor and cold vent piping ,complete plant shutdown for 1 day for maintenance plus the cost of repair.
1	Overpressure case is not expected due to proper design of cold vent (Refer to HAZOP action #72)
2	
3	
4	
5	
6	
7	LV106 is equipped with limit switches with alarm
8	
9	
10	
11	
12	

Action	N.A.

Interlock	PIT053B LL	Design Intent	Protection against low low pressure in QA-V-8007		
Initiators	PIT053B LL	P&ID	12308-2	Final elements	ESDV025-040 (O)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Less Pressure in QA-V-8007 leading to No Flow to fuel gas purge header and to existing facility			a	Failure closed of PV054B downstream QA-E-8006 in HP flare header	0,10	1,00	1,00	0,10	1,00	0,10	1,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									1,00E-03	1,00E-02	**2**
	ENVIRONMENTAL	E	1,00E-03									1,00E-03	1,00E+00	**NC**
	ASSET	B	1,00E-06									1,00E-03	1,00E-03	**3**

NOTES

H	No flow of purge fuel gas to flare leading to possible flare flame out and eventually flash back damage the flare stack, possible mechanical damage leading to possible fatality.
E	No flow of purge fuel gas to flare leading to possible flare flame out
A	Potential damage to flare accessory ; Complete plant shutdown for a long while for maintenance plus the cost of repair .
1	
2	
3	
4	
5	
6	
7	Low Flow alarm in FIT007
8	
9	Alarm in main control room due to flame detector of flare stack
10	
11	
12	

Action	Verify the possibilty to provide a completely independent additional backup circuit for flare header/pilot purging to reduce the SIL value.

Interlock	PIT053A HH	Design Intent	Protection against high high pressure in QA-V-8007		
Initiators	PIT053A HH	P&ID	12308-1	Final elements	ESDV007-025-040 (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overpressurization of QA-V-8006 leading to mechanical damage and release of flammable gas			a	Failure open of PV054B downstream QA-E-8006	0,10	1,00	1,00	1,00	1,00	0,01	1,00E-03		
				b	Failure open of PV054A in HP header	0,10	1,00	1,00	1,00	1,00	0,01	1,00E-03		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	C	1,00E-05									2,00E-03	5,00E-03	**2**
	ENVIRONMENTAL	E	1,00E-03									2,00E-03	5,00E-01	**NC**
	ASSET	C	1,00E-05									2,00E-03	5,00E-03	**2**

NOTES

H	Possibility of significant release of flammable gas. Potential for fatality
E	Possibility of significant release of flammable gas and combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for long period for all compressor train + cost of repair.higher consumption of Diesel fuel for excisting power generator leading to increase of cost
1	
2	
3	
4	
5	
6	
7	
8	
9	PSV055A/B in inlet line of QA-V-8007 sized for control failure scenario
10	
11	
12	

Action	

Interlock	TIT036 HH	Design Intent	Protection against high high temperature in QA-E-8006 outlet		
Initiators	TIT036 HH	P&ID	12308-1	Final elements	QA-E-8006 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8006 leading to mechanical damage			a	Failure of TDIC035 putting to maximum power QA-E-8006	0,10	1,00	1,00	1,00	1,00	0,01	1,00E-03		
				b	Spurious closure of ESDV025 on inlet line to existing facility when the line is in use	0,05	1,00	0,10	0,10	1,00	0,01	5,00E-06		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,01E-03	9,95E-02	**1**
	ENVIRONMENTAL	F	1,00E-02									1,01E-03	9,95E+00	**NC**
	ASSET	E	1,00E-03									1,01E-03	9,95E-01	**NC**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair. avaliabilty of bypass line of QA-E-8006 as per action HAZOP #72
1	
2	
3	
4	
5	
6	TDIC035 with regulation of QA-E-8006
7	High temperature alarm on TDIC035
8	
9	TZA037 high high temperature interlock to shut down electrical heating on QA-E-8006 (classified as SIL2) / FZA028 LL to shutdown electrical heating on QA-E-8006.
10	
11	
12	

Action	

Interlock	TIT037 HH	Design Intent	Protection against high high temperature in QA-E-8006		
Initiators	TIT037 HH	P&ID	12308-1	Final elements	QA-E-8006 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8006 leading to mechanical damage			a	Failure of TDIC035 putting to maximum power QA-E-8006	0,10	1,00	1,00	1,00	1,00	0,10	1,00E-02		
				b	Spurious closure of ESDV025 on inlet line to existing facility when the line is in use	0,05	1,00	0,10	0,10	1,00	0,10	5,00E-05		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,01E-02	9,95E-03	**2**
	ENVIRONMENTAL	F	1,00E-02									1,01E-02	9,95E-01	**NC**
	ASSET	E	1,00E-03									1,01E-02	9,95E-02	**1**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair.avaliabilty of bypass line of QA-E-8006 as per action HAZOP #72
1	
2	
3	
4	
5	
6	TDIC035 with regulation of QA-E-8006
7	High temperature alarm on TDIC035
8	
9	TZA036 high high temperature interlock to shut down electrical heating on QA-E-8006
10	
11	
12	

Action	

Interlock	FIT028 LL	Design Intent	Protection against high high temperature in QA-E-8006		
Initiators	FIT028 LL	P&ID	12308-1	Final elements	QA-E-8006 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8006 leading to mechanical damage			a	Spurious closure of ESDV025 on inlet line to existing facility when the line is in use	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,00E-03	1,00E-01	**1**
	ENVIRONMENTAL	F	1,00E-02									1,00E-03	1,00E+01	**NC**
	ASSET	E	1,00E-03									1,00E-03	1,00E+00	**NC**

NOTES

H	Possibility of release of flammable gas. Potential for injury
E	Limited impact due to combustion fumes dispersion
A	Mechanical damage of fuel gas circuit and stop of production for short period + cost of repair. avaliabilty of bypass line of QA-E-8006 as per action HAZOP #72
1	
2	
3	
4	
5	
6	TDIC035 with regulation of QA-E-8006
7	High temperature alarm on TDIC035
8	
9	TZA036 high high temperature interlock to shut down electrical heating on QA-E-8006
10	
11	
12	

Action	

Interlock	PIT075A LL	Design Intent	Protection of plant for low low pressure of instrument air		
Initiators	PIT075A LL	P&ID	12300-1	Final elements	ESDV038 (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Pressure Less in air distribution network (#08) leading to plant shut down			a	Failure of PIC073 stopping the compressor QA-K-8002A/B/C	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				b	Failure of PIC073 with shut down of QA-K-8002A/B/C	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									2,00E-03	5,00E+00	NC
	ENVIRONMENTAL	E	1,00E-03									2,00E-03	5,00E-01	NC
	ASSET	D	1,00E-04									2,00E-03	5,00E-02	1

NOTES

H	Uncontrolled plant shud down leading to no impact to operators
E	Uncontrolled plant shut down; potential for flaring.
A	Uncontrolled plant shut down; potential for maintenance activity pre start up for 1 day (5M$)
1	
2	
3	
4	
5	
6	PZA079B low low pressure with closure of ESDV015
7	
8	
9	PZA079A/B/C in instrument air main header with total plant shut down
10	
11	
12	

Action	

Interlock	PIT075B LL	Design Intent	Protection of plant for low low pressure of instrument air		
Initiators	PIT075B LL	P&ID	12300-1	Final elements	ESDV015 (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Pressure Less in air distribution network (#08) leading to plant shut down			a	Failure of PIC073 stopping the compressor QA-K-8002A/B/C	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				b	Failure of PIC073 with shut down of QA-K-8002A/B/C	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									2,00E-03	5,00E+00	**NC**
	ENVIRONMENTAL	E	1,00E-03									2,00E-03	5,00E-01	**NC**
	ASSET	D	1,00E-04									2,00E-03	5,00E-02	**1**

NOTES

H	Uncontrolled plant shud down leading to no impact to operators
E	Uncontrolled plant shut down; potential for flaring.
A	Uncontrolled plant shut down; potential for maintenance activity pre start up
1	
2	
3	
4	
5	
6	7,00
7	
8	
9	PZA079A/B/C in instrument air main header with total plant shut down
10	
11	
12	

Action	

Interlock	PIT075B LL	Design Intent	Protection of plant for low low pressure of instrument air		
Initiators	PIT075B LL	P&ID	12300-1	Final elements	ESDV016 (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Pressure Less in air distribution network (#08) leading to plant shut down			a	Failure of PIC073 stopping the compressor QA-K-8002A/B/C	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				b	Failure of PIC073 with shut down of QA-K-8002A/B/C	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									2,00E-03	5,00E+00	**NC**
	ENVIRONMENTAL	E	1,00E-03									2,00E-03	5,00E-01	**NC**
	ASSET	D	1,00E-04									2,00E-03	5,00E-02	**1**

NOTES

H	Uncontrolled plant shud down leading to no impact to operators
E	Uncontrolled plant shut down; potential for flaring.
A	Uncontrolled plant shut down; potential for maintenance activity pre start up
1	
2	
3	
4	
5	
6	PZA079A low low pressure with closure of ESDV038
7	
8	
9	PZA079A/B/C in instrument air main header with total plant shut down
10	
11	
12	

Action	

Interlock	PIT085A/B/C LL	Design Intent	Protection of plant for low low pressure of nitrogen netwoek		
Initiators	PIT085A/B/C LL	P&ID	12301-2	Final elements	ESDV024 (C)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Loss of nitrogen production leading to no nitrogen to seal gas compressor QA-K-8001A/B/C/D with possible damage			a	Failure of PIC086 decreasing pressure of QA-A-8004 to QA-E-8007	0,10	1,00	1,00	1,00	1,00	0,10	1,00E-02		
				b	Spurious opening of BDV-009	0,10	1,00	0,10	1,00	1,00	0,10	1,00E-03		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									1,10E-02	9,09E-01	**NC**
	ENVIRONMENTAL	F	1,00E-02									1,10E-02	9,09E-01	**NC**
	ASSET	E	1,00E-03									1,10E-02	9,09E-02	**1**

NOTES

H	No flow to compressor's seals leading to damage; possible limited flammable gas vent to atmosphere. Very limited impact to operator is expected.
E	No flow to compressor's seals leading to damage; possible limited flammable gas vent to atmosphere.
A	No flow to compressor's seals leading to damage; possible limited plant shut down.
1	
2	
3	
4	
5	
6	
7	BDV-009 is equipped with limit switches with alarm in control room
8	
9	Low low pressure interlock provided inside turbine skid.
10	
11	
12	Team agrees to maintain 2 oo 3 voting logic in order to have high realiabilty against spurious trip .

Action	

Interlock	TIT014 HH	Design Intent	Protection against high high temperature in QA-E-8007 outlet		
Initiators	TIT014 HH	P&ID	12301-2	Final elements	QA-E-8007 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8007 leading to mechanical damage			a	Failure of TDIC013 putting to maximum power QA-E-8007	0,10	1,00	1,00	1,00	1,00	0,01	1,00E-03		
				b	Spurious closure of ESDV025 on inlet line to existing facility when the line is in use	0,05	1,00	0,10	0,10	1,00	0,01	5,00E-06		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									1,01E-03	9,95E+00	**NC**
	ENVIRONMENTAL	F	1,00E-02									1,01E-03	9,95E+00	**NC**
	ASSET	D	1,00E-04									1,01E-03	9,95E-02	**1**

NOTES

H	Possibility of release of nitrogen. Potential for injury
E	Negligible impact due to nitrogen dispersion
A	Mechanical damage of nitrogen circuit and stop of production for some days + cost of repair. availabilty of bypass line of QA-E-8007.
1	
2	
3	
4	
5	
6	TDIC013 with regulation of QA-E-8007
7	High temperature alarm on TDIC013
8	
9	TZA006 high high temperature interlock to shut down electrical heating on QA-E-8007 (Classified as SIL 2)
10	
11	
12	

Action	

Interlock	TIT006 HH	Design Intent	Protection against high high temperature in QA-E-8007 outlet		
Initiators	TIT006 HH	P&ID	12301-2	Final elements	QA-E-8007 (T)
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overheating of QA-E-8007 leading to mechanical damage			a	Failure of TDIC013 putting to maximum power QA-E-8007	0,10	1,00	1,00	1,00	1,00	0,10	1,00E-02		
				b	Spurious closure of ESDV025 on inlet line to existing facility when the line is in use	0,10	1,00	0,10	0,10	1,00	0,10	1,00E-04		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	F	1,00E-02									1,01E-02	9,90E-01	**NC**
	ENVIRONMENTAL	F	1,00E-02									1,01E-02	9,90E-01	**NC**
	ASSET	D	1,00E-04									1,01E-02	9,90E-03	**2**

NOTES

H	Possibility of release of nitrogen. Potential for injury
E	Negligible impact due to nitrogen dispersion
A	Mechanical damage of nitrogen circuit and stop of production for short period + cost of repair.
1	
2	
3	
4	
5	
6	TDIC013 with regulation of QA-E-8007
7	High temperature alarm on TDIC013
8	
9	TZA016 high high temperature interlock to shut down electrical heating on QA-E-8007
10	
11	
12	

Action	

Interlock	PITXXXA HH (2)	Design Intent	Protection against high high pressure down stream letdown package QA-A-8004		
Initiators	PITXXXA HH (2)	P&ID	12301	Final elements	ESDVXXX
Remarks					

Ref.	1	2		3		4	5	6	7	8	9	10	11	
							Protection layers (PL)							
	Impact event description	Impact level	TMEL (occ./year)	#	Cause	Initiation likelihood (occ./year)	Time risk	BPCS	Alarms	Vulnerability (health)	Additional IPL	Intermediate Event likelihood	SIF integritiy level	SIL
1	Overpressurization of Nitrogen header to gas turbine seals leading to mechanical damage.			a	Failure open of letdown package	0,10	1,00	1,00	1,00	1,00	0,01	1,00E-03		
				b								0,00E+00		
				c								0,00E+00		
				d								0,00E+00		
				e								0,00E+00		
	HEALTH	D	1,00E-04									1,00E-03	1,00E-01	**1**
	ENVIRONMENTAL	F	1,00E-02									1,00E-03	1,00E+01	**NC**
	ASSET	D	1,00E-04									1,00E-03	1,00E-01	**1**

NOTES

H	Possibility of release of nitrogen. Potential for permenant injury, since letdown package is installed inside a confined area.
E	No impact on environment
A	Unexpected complete shut down of site (gas plant and oil plant) for one day.
1	
2	
3	
4	
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6	
7	
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9	
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12	

Action	Install PSV downstream letdown package QA-A-8004 sized for control valve failure in order to reduce the SIL value from 3 to 1 .